US009421801B2

(12) **United States Patent**
Mimoto et al.

(10) **Patent No.: US 9,421,801 B2**
(45) **Date of Patent: Aug. 23, 2016**

(54) **INKJET RECORDING APPARATUS**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **14/227,843**

(22) Filed: **Mar. 27, 2014**

(65) **Prior Publication Data**

US 2015/0091981 A1 Apr. 2, 2015

(30) **Foreign Application Priority Data**

Sep. 30, 2013 (JP) 2013-205988

(51) **Int. Cl.**

B41J 25/304	(2006.01)
B41J 29/02	(2006.01)
B41J 13/076	(2006.01)
B41J 29/13	(2006.01)

(52) **U.S. Cl.**

CPC ***B41J 29/02*** (2013.01); ***B41J 13/076*** (2013.01); ***B41J 29/13*** (2013.01)

(58) **Field of Classification Search**

CPC B41J 29/02

USPC 400/352, 59; 347/8, 16, 5, 9

See application file for complete search history.

(56) **References Cited**

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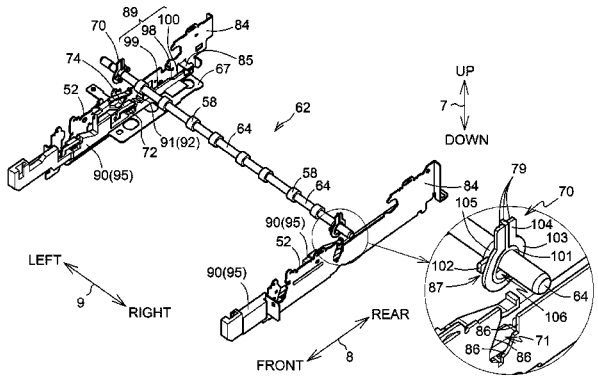
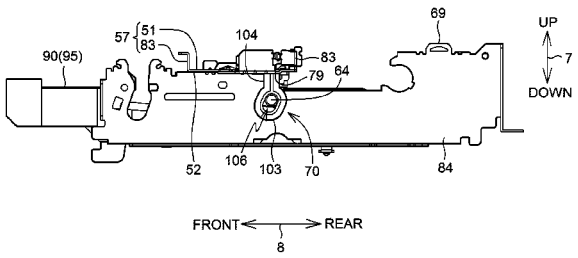
(57) **ABSTRACT**

An inkjet recording apparatus and method of operation are disclosed. One such apparatus includes a carriage configured to support a recording head that is configured to eject ink from nozzles onto a recording medium to be conveyed, and a first support member supporting the carriage. The carriage is movable in a scanning direction orthogonal to a transporting direction of the recording medium. The apparatus further includes a second support member configured to support the first support member and a transporting roller extending in the scanning direction and rotatable to transport the recording medium in the transporting direction. The apparatus also includes a bearing disposed at the second support member and supporting the transporting roller rotatably, the bearing comprising a contact portion that contacts the first support member.

18 Claims, 9 Drawing Sheets





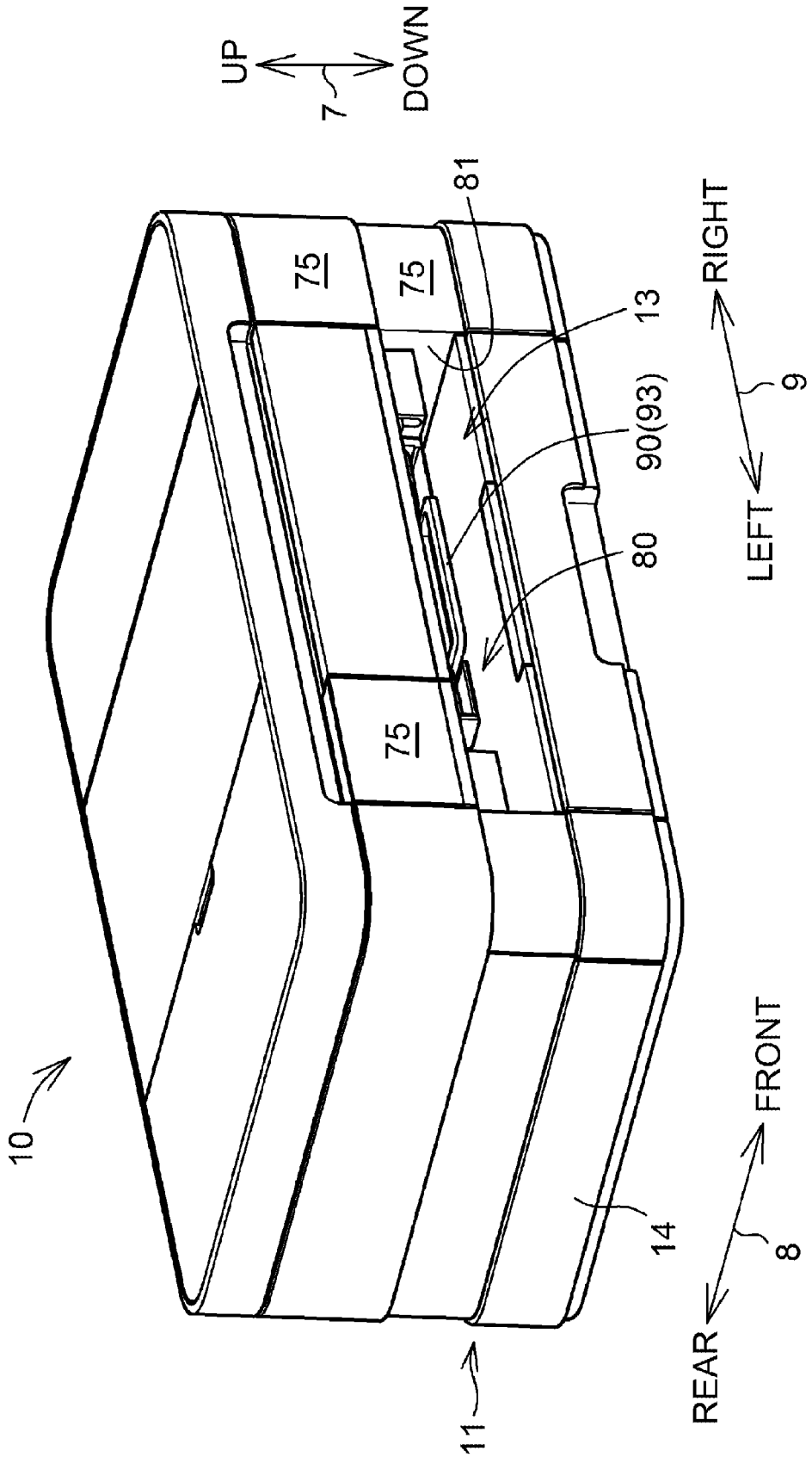
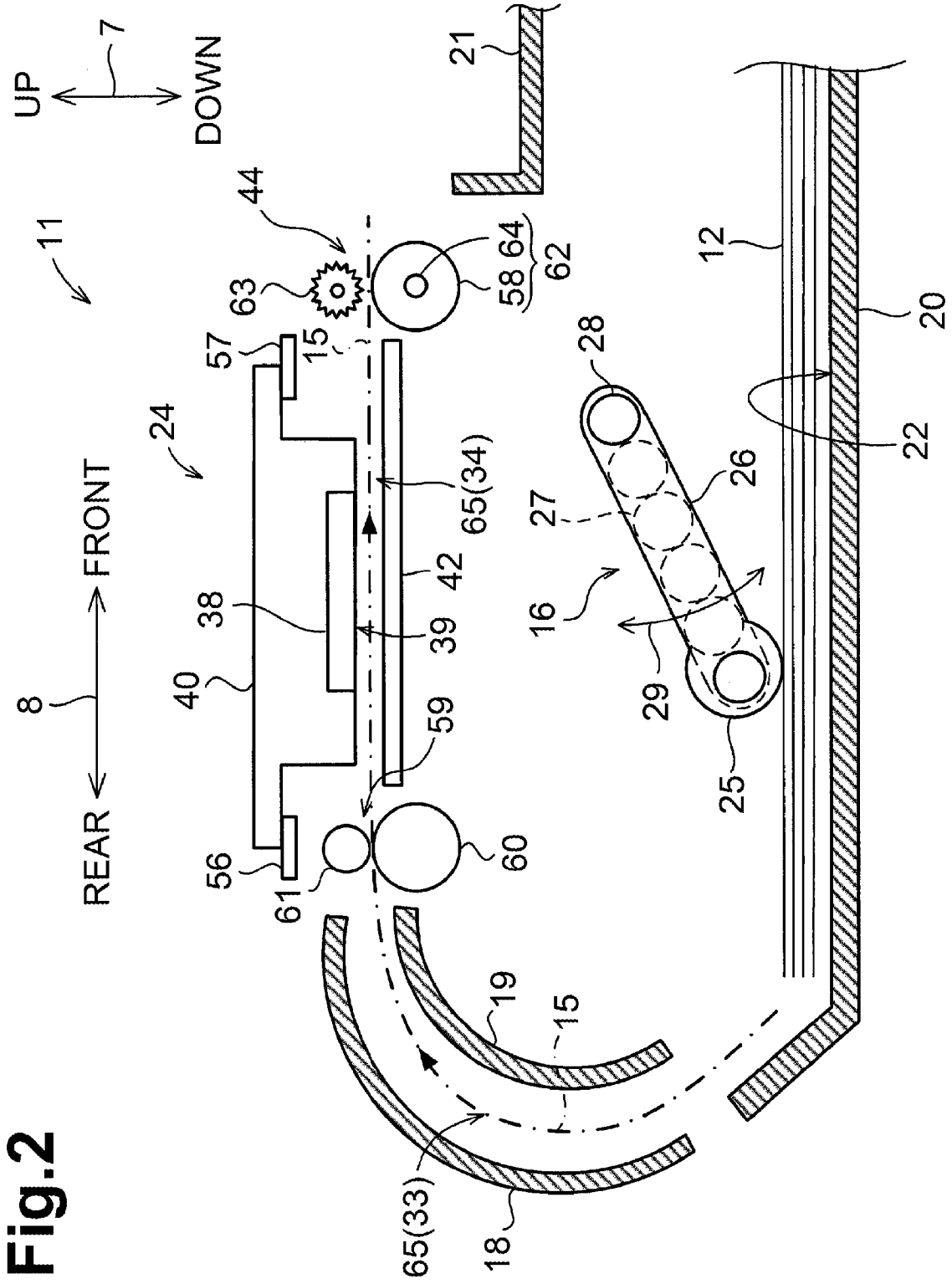


Fig.1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65(33)
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Fig.2

Fig.3A

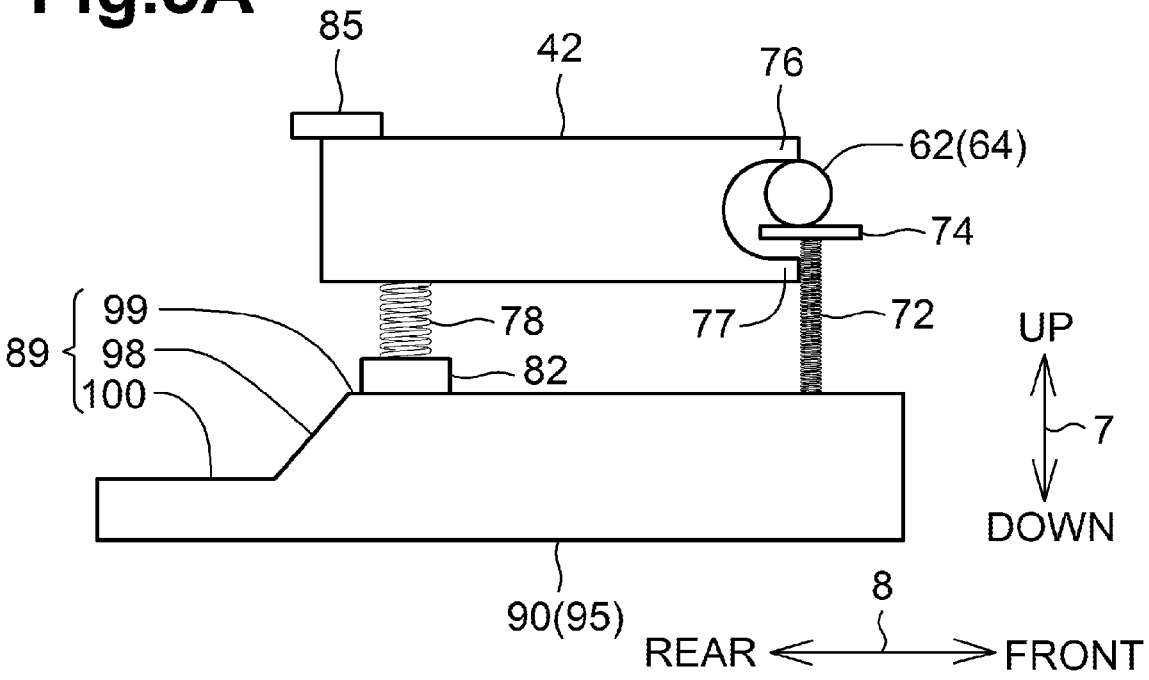
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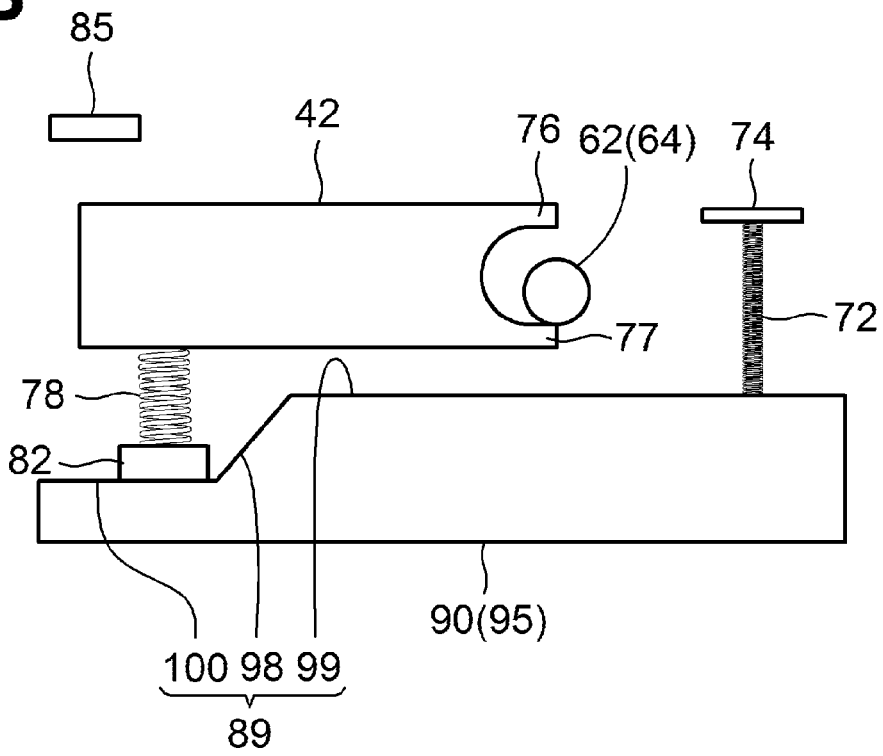
Fig.3B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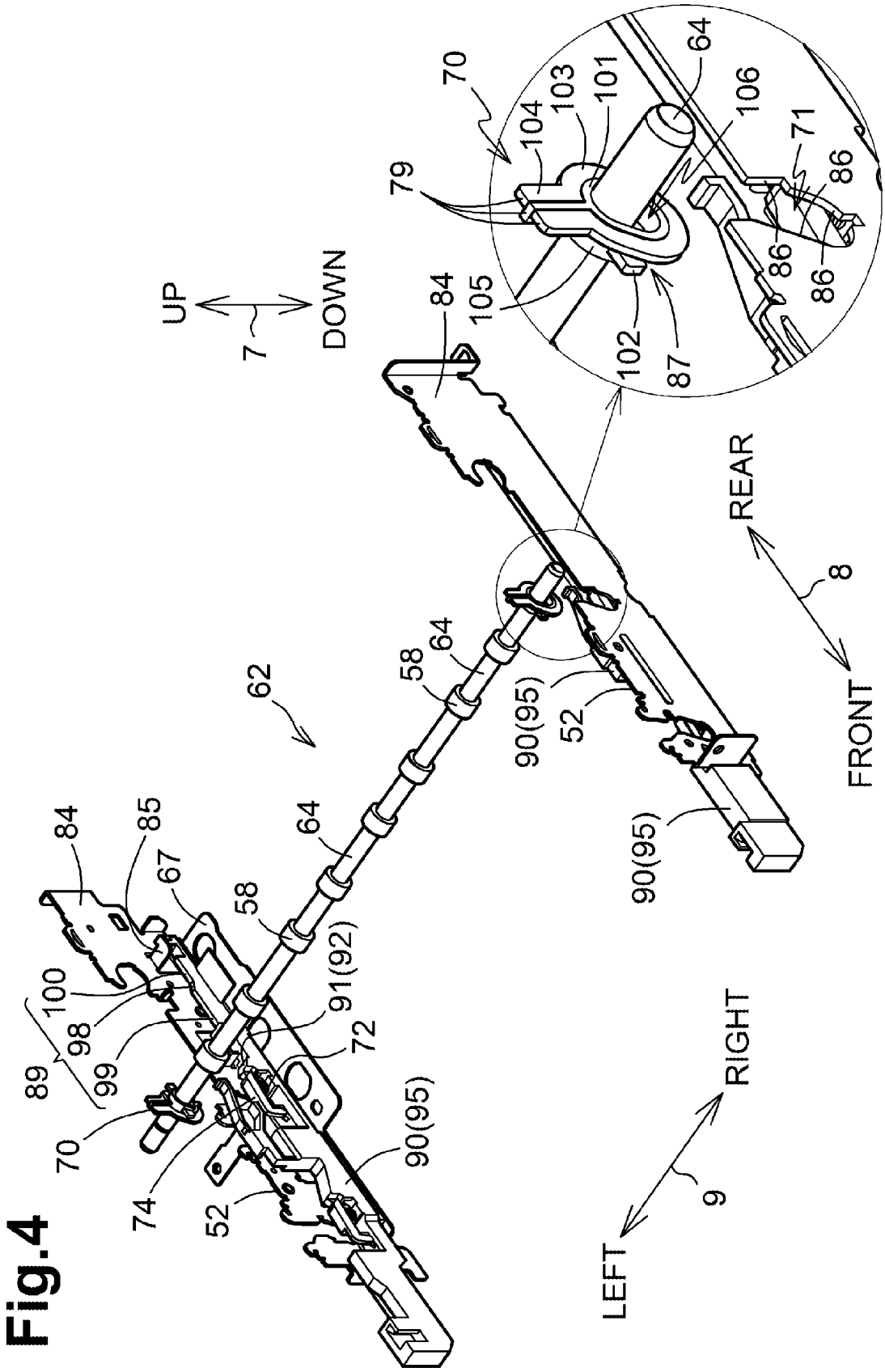
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90(95)
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Fig.4

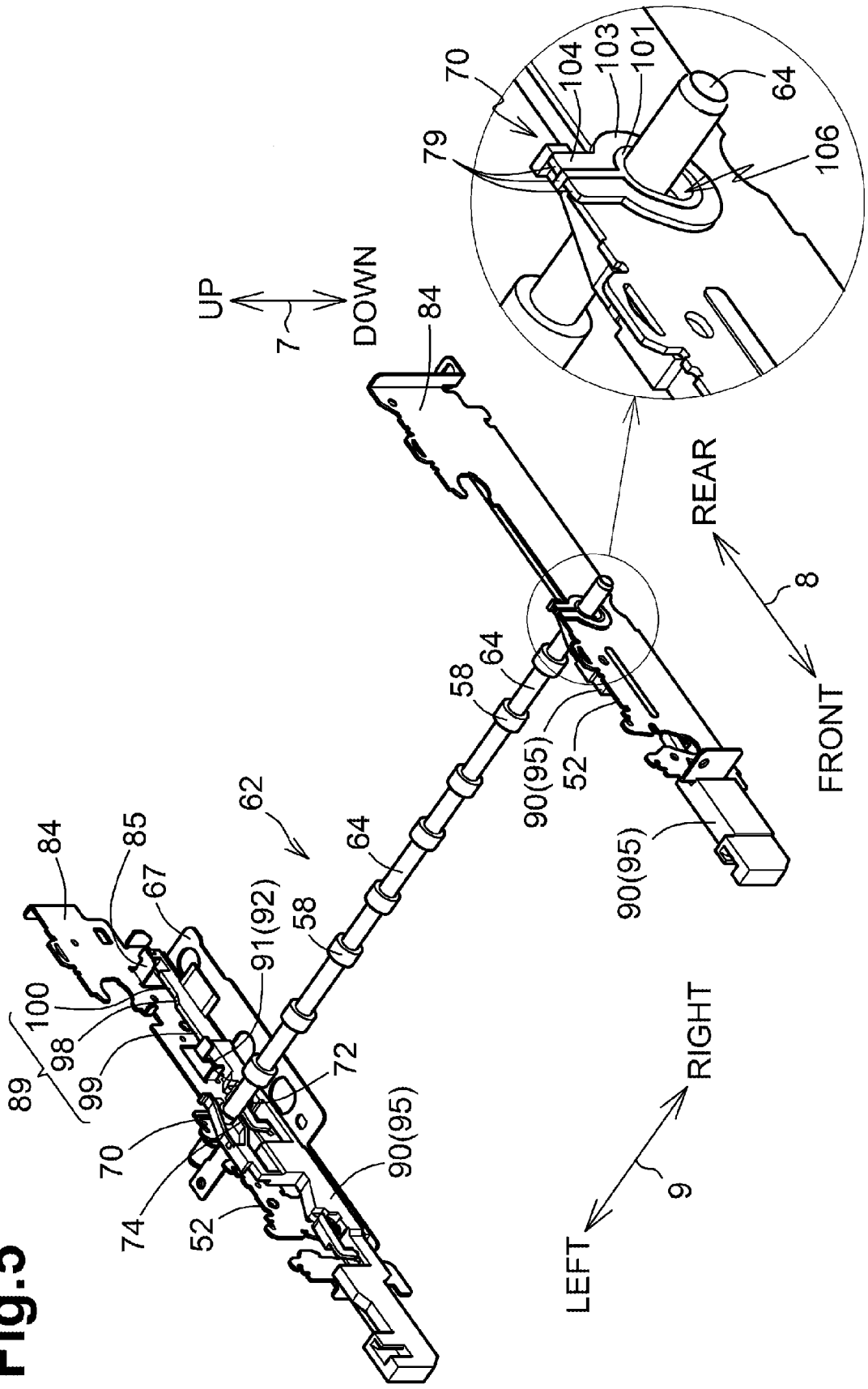
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Fig.5

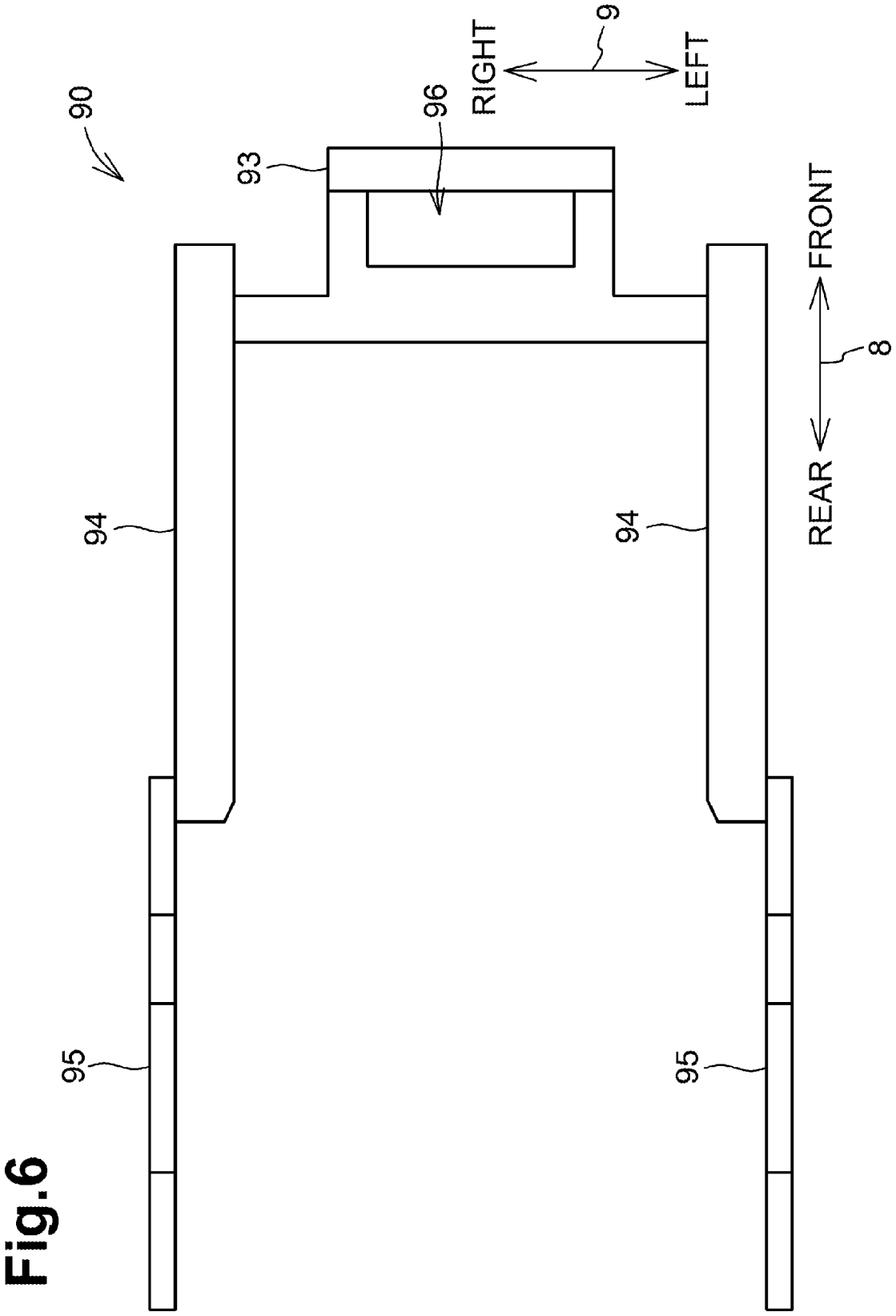

Fig.6

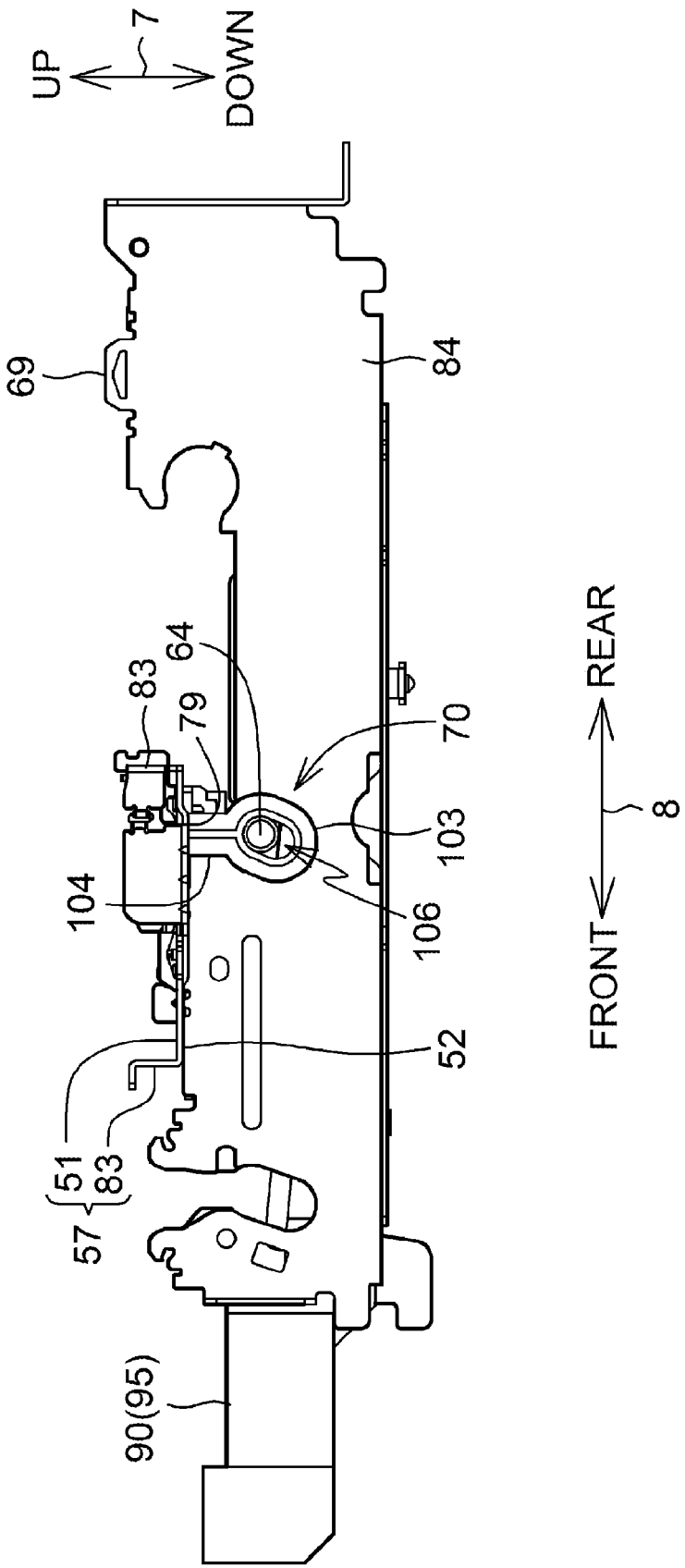
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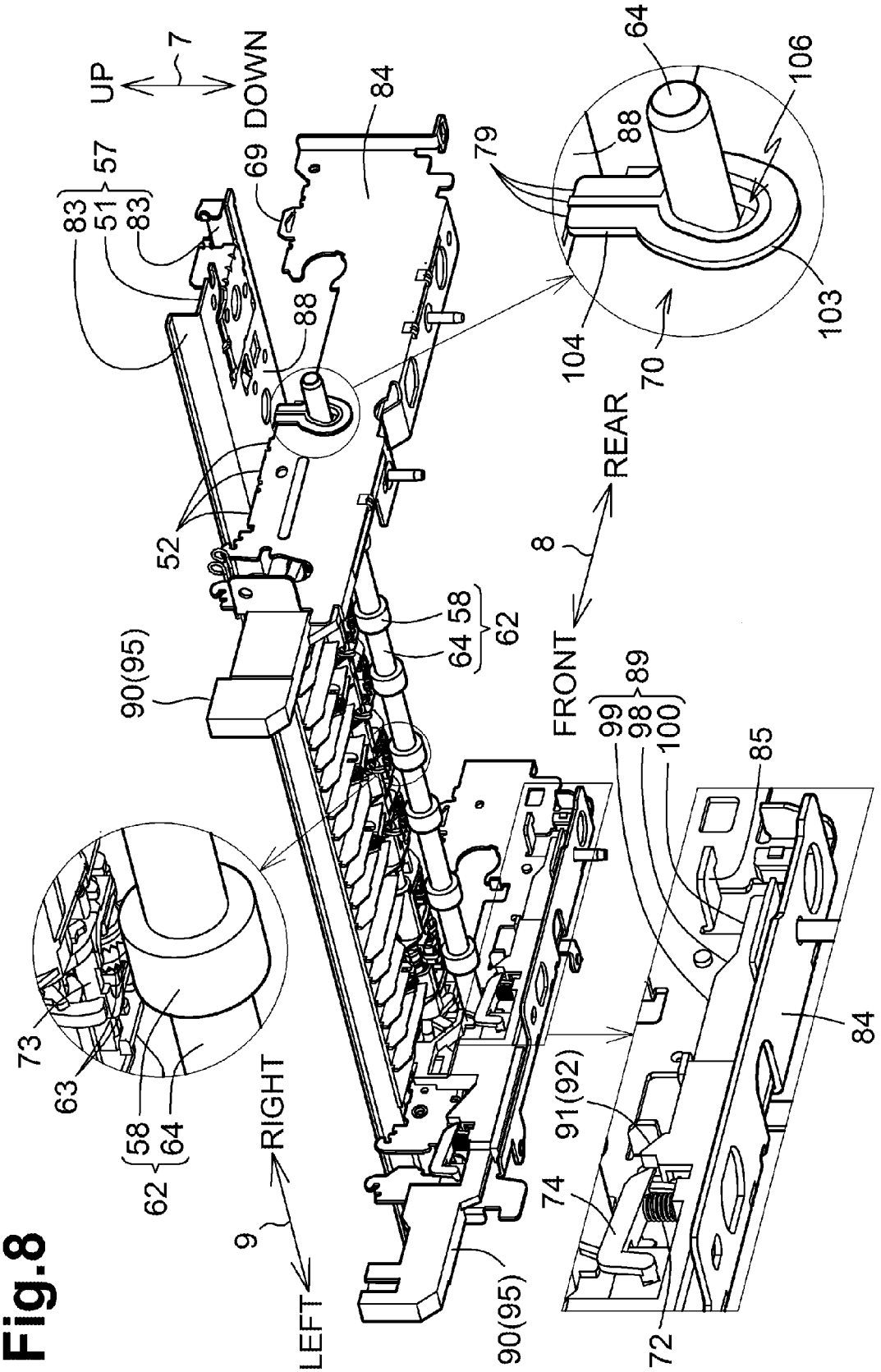
Fig.7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74
90(95)
72

Fig.8

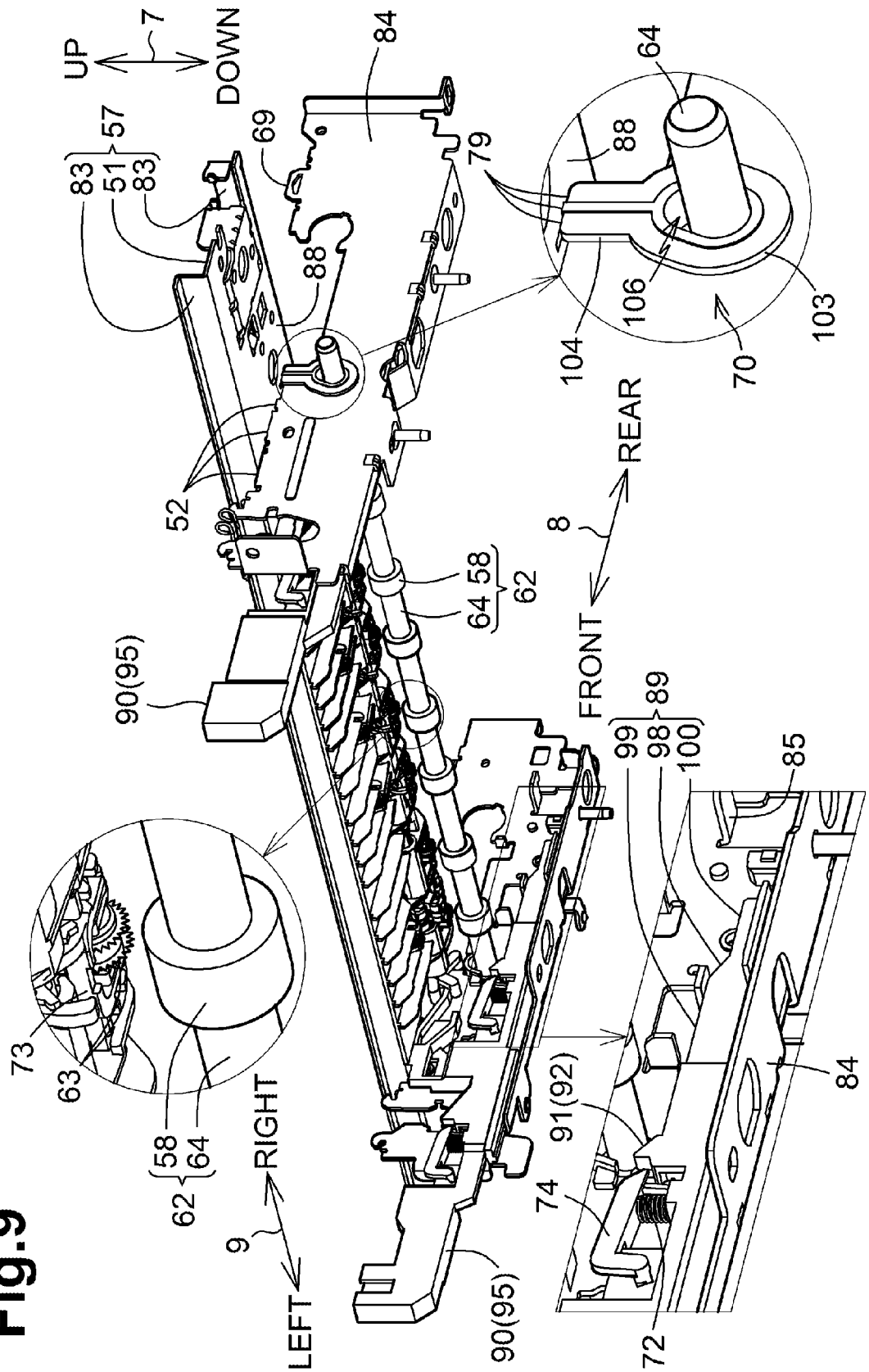
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Fig.9

INKJET RECORDING APPARATUS

CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority from Japanese Patent Application No. 2013-205988, filed on Sep. 30, 2013, which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

The present invention relates to an inkjet recording apparatus that records an image on a sheet by ejecting ink droplets from nozzles.

BACKGROUND

Many inkjet recording apparatuses include pairs of rollers that each transport a sheet while nipping the sheet therebetween. Such a pair of rollers includes a transporting roller that rotates by receiving a driving force transmitted thereto from a motor, and a follower roller that faces the transporting roller and rotates by following the rotation of the transporting roller. The transporting roller is rotatably supported by a bearing.

In a known image forming apparatus, a bearing that supports a roller is attached to a frame by inserting the bearing into an opening, provided in the frame, in the axial direction of the roller.

SUMMARY

If, however, a recording unit that records an image on a sheet is supported by a frame that is separate from the frame to which the bearing is attached, the frame serving as a reference for the positioning of the recording unit is provided separately from the frame serving as a reference for the positioning of the bearing. Therefore, the accuracy in the relative positions of the recording unit and the roller that is supported by the bearing may be deteriorated.

In light of the above, the present invention provides a mechanism that improves the accuracy in the relative positions of a recording unit and a roller that is supported by a bearing.

According to the present configuration, a contact portion provided on a bearing is in contact with a first support member from below. The first support member supports a carriage that carries a recording head. Hence, the recording head and a transporting roller are positioned with reference to the first support member. Therefore, the accuracy in the relative positions of the recording head and the transporting roller is improved.

According to one example aspect, an inkjet recording apparatus includes a carriage configured to support a recording head that is configured to eject ink from nozzles onto a recording medium to be conveyed. The inkjet recording apparatus also includes a first support member supporting the carriage, the carriage being movable in a scanning direction orthogonal to a transporting direction of the recording medium. The inkjet recording apparatus includes a second support member configured to support the first support member, and a transporting roller extending in the scanning direction and rotatable to transport the recording medium in the transporting direction. The inkjet recording apparatus further includes a bearing disposed at the second support member and supporting the transporting roller rotatably, the bearing comprising a contact portion that contacts the first support member.

According to a second example aspect, a method of operation of an inkjet recording apparatus is disclosed. The method includes movably mounting a carriage to a first support member, the carriage configured to support a recording head that is configured to eject ink from nozzles onto a recording medium to be conveyed, and positioning a bearing at a second support member, the bearing rotatably supporting a transporting roller that extends in a scanning direction. The method further includes maintaining contact between a contact portion of the bearing and the first support member.

According to a third example aspect, an inkjet recording apparatus includes a carriage configured to support a recording head that is configured to eject ink from nozzles onto a recording medium to be conveyed. The inkjet recording apparatus also includes a guide rail supporting the carriage, the carriage being movable in a scanning direction orthogonal to a transporting direction of the recording medium, as well as at least one side frame supporting the guide rail and a transporting roller extending in the scanning direction and rotatable to transport the recording medium in the transporting direction. The inkjet recording apparatus further includes a bearing attached to the at least one side frame and supporting the transporting roller rotatably, the bearing comprising a contact portion positioned in an opening of the side frame facing the guide rail and contacting the guide rail.

According to some aspects of the present disclosure, the accuracy in the relative positions of the carriage that carries the recording head and the transporting roller that is supported by the bearing is improved.

DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present disclosure, needs satisfied thereby, and the objects, features, and advantages thereof, reference now is made to the following descriptions taken in connection with the accompanying drawings.

FIG. **1** is a perspective view of an exemplary multifunction machine according to an embodiment of the present invention;

FIG. **2** is a vertical sectional view schematically illustrating an internal configuration of a printer section included in the multifunction machine;

FIG. **3**A is a left side view schematically illustrating part of the printer section including one of guiding portions of a lever unit, a platen, and associated elements, with the lever unit residing at a rear position;

FIG. **3**B is another left side view schematically illustrating the part of the printer section including the guiding portion of the lever unit, the platen, and associated elements, with the lever unit residing at a front position;

FIG. **4** is a perspective view illustrating a pair of side frames, the guiding portions, a second roller, and bearings, with the bearings not being fitted in the respective side frames and the lever unit residing at the rear position;

FIG. **5** is another perspective view illustrating the pair of side frames, the guiding portions, the second roller, and the bearings, with the bearings being fitted in the respective side frames and the lever unit residing at the rear position;

FIG. **6** is a plan view schematically illustrating the lever unit;

FIG. **7** is a right side view illustrating one of the side frames that is on the right side and associated elements;

FIG. **8** is a perspective view illustrating a guide rail, the pair of side frames, the guiding portions, the second roller, and the bearings, with the lever unit residing at the rear position; and

FIG. **9** is another perspective view illustrating the guide rail, the pair of side frames, the guiding portions, the second roller, and the bearings, with the lever unit residing at the front position.

DETAILED DESCRIPTION

Embodiments of the present disclosure will now be described with reference to the accompanying drawings. The embodiments given below are only an example of the present invention, and any changes can be made thereto without departing from the scope of the present invention. In the following description, a vertical direction **7** (e.g., the "up/down" direction shown in FIG. **1**) is defined in a state where a multifunction machine **10** is set in one possible usable manner (the state illustrated in FIG. **1**), an anteroposterior direction **8** is defined with a side of the multifunction machine **10** on which an opening **13** is provided being the near side (front side), and a lateral direction **9** is defined when the multifunction machine **10** is seen from the near side (front side).

[Overall Configuration of Multifunction Machine **10**]

As illustrated in FIG. **1**, the multifunction machine **10** has a substantially rectangular parallelpiped shape with a small thickness and includes a printer section **11** (an exemplary inkjet recording apparatus according to the present invention) on the lower side thereof. The multifunction machine **10** has several functions such as a facsimile function and a printing function. The multifunction machine **10** has, as a printing function, a function of recording an image on one side of a recording sheet **12** (see FIG. **2**) in an inkjet manner. The multifunction machine **10** may also have a function of recording an image on each of two sides of the recording sheet **12**.

[Feed Tray **20**]

As illustrated in the example shown in FIG. **1**, the printer section **11** includes a housing **14**. The housing **14** has the opening **13** provided in a front wall **75** thereof. The housing **14** also has a recessed portion **80** on the front side thereof. The recessed portion **80** is recessed rearward from the opening **13**. A feed tray **20** is movable in the anteroposterior direction **8**, thereby being insertable into and removable from the recessed portion **80** through the opening **13**. The feed tray **20** is a box-like member whose upper side is open. As illustrated in FIG. **2**, a stack of recording sheets **12** (pieces of an exemplary recording medium according to the present disclosure) is placed on a bottom plate **22** of the feed tray **20**. That is, the feed tray **20** is capable of storing recording sheets **12**.

[Output Tray **21**]

As illustrated in the example of FIG. **2**, an output tray **21** is supported on the upper front side of the feed tray **20**. The output tray **21** is movable in the anteroposterior direction **8** together with the feed tray **20**. The output tray **21** is set in the recessed portion **80** together with the feed tray **20**. In such a state, the upper surface of the output tray **21** receives a recording sheet **12** that has been transported thereto by a second pair of rollers **44** to be described separately below.

[Feeding Unit **16**]

As illustrated in the example of FIG. **2**, a feeding unit **16** is provided above the bottom plate **22** of the feed tray **20** that is set in the recessed portion **80**. The feeding unit **16** includes a feeding roller **25**, a feeding arm **26**, and a power transmitting mechanism **27**. The feeding roller **25** is supported at the distal end of the feeding arm **26**. The feeding arm **26** is rotatable in a direction of an arrow **29** about a rod **28** provided at the proximal end thereof. Hence, the feeding roller **25** is movable to and away from the stack of recording sheets **12** supported by the bottom plate **22** of the feed tray **20** or the feed tray **20**.

The feeding roller **25** is rotated by a driving force transmitted thereto from a transport motor (not illustrated) via the power transmitting mechanism **27**. The power transmitting mechanism **27** includes a plurality of gears that are in mesh with one another. In this manner, the uppermost one of the recording sheets **12** on the bottom plate **22** of the feed tray **20** that is in contact with the feeding roller **25** is fed into a transport path **65** to be described below. The feeding roller **25** may be rotated by a driving force transmitted thereto from a motor provided separately from the transport motor.

[Transport Path **65**]

As illustrated in the example of FIG. **2**, the transport path **65** extends in the housing **14** from the rear end of the feed tray **20**. The transport path **65** includes a bent portion **33** and a linear portion **34**. The bent portion **33** extends from the rear end of the feed tray **20** while being bent upward. The linear portion **34** extends in the anteroposterior direction **8**.

The bent portion **33** is defined by an outer guide member **18** and an inner guide member **19** that face each other with a predetermined gap interposed therebetween. The linear portion **34** is defined, at a position where a recording unit **24** is provided, by the recording unit **24** and a platen **42** that face each other with a predetermined gap interposed therebetween.

The recording sheets **12** supported by the feed tray **20** are each fed into the bent portion **33** by the feeding roller **25** and is transported from the bent portion **33** to the linear portion **34** in a transporting direction **15** represented by the dash-dot-line arrow illustrated in FIG. **2**. That is, each of the recording sheets **12** is transported in the anteroposterior direction **8** (an exemplary transporting direction according to the present disclosure) in the linear portion **34**.

[Recording Unit **24**]

As illustrated in the example of FIG. **2**, the recording unit **24** is provided above the linear portion **34**. The recording unit **24** includes a carriage **40** and a recording head **38**.

The carriage **40** is supported by two guide rails **56** and **57** that are spaced apart from each other in the anteroposterior direction **8**, whereby the carriage **40** is movable back and forth in the lateral direction **9** (an exemplary scanning direction according to the present disclosure). The direction of the movement of the carriage **40** is the lateral direction **9** that is orthogonal to the transporting direction **15** in which the recording sheet **12** is transported, but is not limited to the lateral direction **9** as long as the direction of the movement of the carriage **40** crosses the transporting direction **15**. The guide rails **56** and **57** will be described in detail separately below.

The recording head **38** is carried by the carriage **40**. Ink is supplied from an ink cartridge (not illustrated) to the recording head **38**. The recording head **38** has nozzles **39** in the lower surface thereof.

The platen **42** is provided at a position below the recording head **38** and faces the recording unit **24**. The platen **42** supports the recording sheet **12** that is transported in the linear portion **34** of the transport path **65**. The platen **42** will be described in detail separately below.

While the carriage **40** is moving in the lateral direction **9**, the recording head **38** ejects ink droplets from the nozzles **39** toward the recording sheet **12** that is being transported in the transporting direction **15** while being supported by the platen **42**. Thus, an image is recorded on the recording sheet **12**.

[Guide Rails **56** and **57**]

As illustrated in FIG. **2**, the guide rail **56** is provided on the rear side with respect to the recording head **38** and supports a rear portion of the recording unit **24**. The guide rail **57** (an exemplary first support member according to the present

invention) is provided on the front side with respect to the recording head **38** and supports a front portion of the recording unit **24**.

As illustrated in FIGS. **7** to **9**, the guide rails **56** and **57** each include a flat portion **51** extending in the lateral direction **9**, and upright portions **83** extending upward from two respective ends, in the anteroposterior direction **8**, of the flat portion **51**. The flat portion **51** has a substantially flat-plate-like shape whose lengths in the anteroposterior direction **8** and in the lateral direction **9** are larger than that in the vertical direction **7**.

In alternative embodiments, the positions of the upright portions **83** are not limited to the two respective ends of the guide rail **57** in the anteroposterior direction **8**. For example, the upright portions **83** may be provided in a central part of the guide rail **57** in the anteroposterior direction **8**. Moreover, the number of upright portions **83** may be one or more. The upright portions **83** are each preferably provided at a position that does not coincide with a position of a third projecting portion **104** of a corresponding one of bearings **70**, to be described separately below, in the anteroposterior direction **8**. Nevertheless, the upright portions **83** may each be provided at a position that coincides with the position of the third projecting portion **104** of the bearing **70** in the anteroposterior direction **8**.

A known belt mechanism (not illustrated) is provided on the flat portion **51** of the guide rail **57**. The belt mechanism includes pulleys provided at the right and left ends, respectively, on the upper surface of the guide rail **57**, and a belt stretched between the pulleys. The belt is connected to the carriage **40** and to a carriage driving motor (not illustrated) that provides a driving force to the carriage **40**. When the carriage driving motor is activated, a driving force acting in the lateral direction **9** is transmitted to the carriage **40** via the belt mechanism. Thus, the carriage **40** moves back and forth in the lateral direction **9**.

[Side Frames **84**]

As illustrated in the example of FIGS. **4** and **5**, the printer section **11** includes a pair of side frames **84** (exemplary second support member according to the present invention) that are spaced apart from each other in the lateral direction **9**. The pair of side frames **84** are provided on right and left sides, respectively, in the lateral direction **9** with respect to the linear portion **34**. The side frames **84** are each a substantially flat-plate-like member whose lengths in the vertical direction **7** and in the anteroposterior direction **8** are larger than that in the lateral direction **9**.

As illustrated in the example of FIGS. **7** to **9**, the pair of side frames **84** are provided below the guide rail **57** and support the guide rail **57** from below. The pair of side frames **84** also support the guide rail **56** at a position **69** that is on the rear side with respect to the position where the pair of side frames **84** support the guide rail **57**. In FIGS. **7** to **9**, the guide rail **56** is not illustrated.

As illustrated in the example of FIG. **4**, a lower end portion of each of the pair of side frames **84** is bent toward the other side frame **84**, that is, toward the inner side in the lateral direction **9**. Upper surfaces **67** of the bent portions support a lever unit **90** to be described separately below.

As illustrated in the example of FIG. **4**, the pair of side frames **84** each have a fitting portion **71** that is open in an arc shape and extends downward from the upper end thereof. The fitting portion **71** receives a corresponding one of the bearings **70** to be described separately below.

The pair of side frames **84** each have a projecting portion **85** (an exemplary platen contact portion according to the present invention) projecting toward the other side frame **84**. The projecting portion **85** is provided on the rear side with respect to a second roller **62** to be described separately below. The projecting portion **85** is brought into contact with the upper surface of the platen **42**, to be described separately below, from above (see FIG. **3**A).

[First Pair of Rollers **59** and Second Pair of Rollers **44**]

As illustrated in the example of FIG. **2**, a first pair of rollers **59** is provided in the linear portion **34** on the upstream side in the transporting direction **15** with respect to the recording head **38** of the recording unit **24**. The second pair of rollers **44** is provided in the linear portion **34** on the downstream side in the transporting direction **15** with respect to the recording head **38** of the recording unit **24**.

The first pair of rollers **59** includes a first roller **60** provided on the lower side of the linear portion **34**, and a pinch roller **61** provided on the upper side of the linear portion **34** and facing the first roller **60**. The first roller **60** and the pinch roller **61** each rotate about an axis extending in the lateral direction **9**. The pinch roller **61** is pressed against the first roller **60** by an urging member (not illustrated) such as a coil spring. Hence, when the first roller **60** rotates, the pinch roller **61** rotates by following the rotation of the first roller **60**.

As illustrated in the example of FIG. **2**, the second pair of rollers **44** includes the second roller **62** (an exemplary transporting roller according to the present invention) provided on the lower side of the linear portion **34**, and a plurality of spurs **63** (an exemplary follower roller according to the present invention) provided on the upper side of the linear portion **34** and facing the second roller **62**.

As illustrated in the example of FIG. **4**, the second roller **62** includes a shaft **64** extending in the lateral direction **9**, and roller members **58** provided on the shaft **64** at specific intervals in the lateral direction **9**. That is, the second roller **62** extends in the lateral direction **9**.

As illustrated in the example of FIG. **8**, the spurs **63** that are arranged at specific intervals in the lateral direction **9** face the respective roller members **58**. The spurs **63** are provided on the guide rail **57**. More specifically, a shaft extending through the spurs **63** in the lateral direction **9** is rotatably supported by supporting members **73** provided on the lower surface of the guide rail **57**.

The second roller **62** is urged upward by coil springs **72** (exemplary first urging members according to the present invention, see FIG. **4**). The coil springs **72** will now be described in detail. As illustrated in FIG. **4**, the coil springs **72** are each connected to the lever unit **90** at the lower end thereof and to a corresponding one of supporting members **74** at the upper end thereof. The lever unit **90**, to be described separately below, is movable. Hence, the coil springs **72** and the supporting members **74** move together with the lever unit **90**. When the lever unit **90** is at a rear position as illustrated in FIGS. **5** and **8**, the supporting members **74** are in contact with the shaft **64** of the second roller **62** from below. Hence, the coil springs **72** urge the second roller **62** upward, e.g., toward the spurs **63** when the second roller **62** and the spurs **63** are in the positions shown in FIG. **2** and the coil springs **72** are positioned and oriented as shown in FIGS. **3**A-**3**B. Thus, the second roller **62** and the spurs **63** are in contact with each other, and, when the second roller **62** rotates, the spurs **63** rotate by following the rotation of the second roller **62**.

The first roller **60** and the second roller **62** rotate by receiving a driving force transmitted thereto from the transport motor (not illustrated). When the first roller **60** rotates with a recording sheet **12** nipped between the first pair of rollers **59**, the recording sheet **12** is transported onto the platen **42** by the first pair of rollers **59**, that is, the recording sheet **12** is transported in the transporting direction **15**. When the second

roller **62** rotates with the recording sheet **12** nipped between the second pair of rollers **44**, the recording sheet **12** is transported in the transporting direction **15** by the second pair of rollers **44** and is discharged onto the output tray **21** provided in the recessed portion **80**.

The shaft **64** of the second roller **62** is provided with gears (not illustrated) that are rotatable about the shaft **64**. The gears are in mesh with respective transmission gears so that the driving force from the transport motor is transmitted thereto. The gears on the shaft **64** are provided adjacent to the respective bearings **70** in the lateral direction **9**. The bearings **70** will be described separately below.

[Platen **42**]

The platen **42** has a substantially flat-plate-like shape whose lengths in the anteroposterior direction **8** and in the lateral direction **9** are larger than that in the vertical direction **7**.

As illustrated in the examples of FIGS. **3**A and **3**B, the platen **42** has at the front end thereof a plurality of upper projections **76** (an exemplary roller contact portion according to the present invention) and a plurality of lower projections **77**. The upper projections **76** and the lower projections **77** extend frontward from an upper portion and a lower portion, respectively, at the front end of the platen **42**. The upper projections **76** and the lower projections **77** are arranged at specific intervals in the lateral direction **9**. The positions of the upper projections **76** and the positions of the lower projections **77** in the lateral direction **9** may be the same as or different from each other.

The shaft **64** of the second roller **62** is placed in a space defined between the upper projections **76** and the lower projections **77** in the vertical direction **7**. As illustrated in FIG. **3**A, when the lever unit **90** is at the rear position, the upper projections **76** are in contact with the shaft **64** that is urged upward by the coil springs **72**. Hence, the platen **42** is urged upward by the coil springs **72**.

Coil springs **78** (an exemplary second urging member according to the present invention) are provided on the rear side with respect to the upper projections **76**. The upper end of each of the coil springs **78** is connected to the lower surface of the platen **42**. The lower end of each of the coil springs **78** is connected to a corresponding one of supporting members **82**. The supporting members **82** are each supported by a corresponding one of guiding surfaces **89** of the lever unit **90**. As illustrated in FIG. **3**A, when the lever unit **90** is at the rear position, the platen **42** is urged upward by the coil springs **78** at positions, in the anteroposterior direction **8**, not coinciding with the position where the upper projections **76** are provided. The upper surface of the platen **42** that is urged upward by the coil springs **78** is in contact with the projecting portions **85** from below. The projecting portions **85** are provided on the respective side frames **84**. That is, the projecting portions **85** stop the upward movement of the platen **42** that is urged by coil springs **78**. Thus, the state of contact between the upper projections **76** and the shaft **64** of the second roller **62** is maintained.

[Bearing **70**]

As illustrated in the example of FIG. **4**, the bearings **70** each include a cylindrical body **101** having an opening **106**, a first projecting portion **102** projecting from an outer circumferential surface **105** of the cylindrical body **101**, a second projecting portion **103** spaced apart from the first projecting portion **102** in the lateral direction **9** and projecting from the outer circumferential surface **105**, and the third projecting portion **104** projecting from the second projecting portion **103**.

The following description of the bearing **70** is given on the basis of a state where the bearing **70** is oriented as illustrated in FIG. **4** and with reference to the vertical direction **7**, the anteroposterior direction **8**, and the lateral direction **9**.

The length of the body **101** in the anteroposterior direction **8** is substantially the same as the inside diameter of the fitting portion **71**. The opening **106** is an oblong hole extending substantially in the vertical direction **7** (an exemplary direction that crosses the transporting direction and the scanning direction according to the present invention). In the embodiment, the opening **106** extends obliquely with respect to the vertical direction **7** with the upper end thereof residing on the rear side with respect to the lower end thereof. The direction in which the opening **106** extends is not limited to such a direction and may be any direction that crosses the anteroposterior direction **8** and the lateral direction **9**. For example, the opening **106** may extend in the vertical direction **7**.

The length of the opening **106** in the long-side direction thereof (in the vertical direction **7**) corresponds to the length of travel of the second roller **62**, to be described separately below, in the vertical direction **7**. The length of the opening **106** in the short-side direction (the anteroposterior direction **8**) is substantially the same as the diameter of the shaft **64** of the second roller **62**. A groove **87** is provided between the first projecting portion **102** and the second projecting portion **103**. The width of the groove **87** (the length in the lateral direction **9**) is substantially the same as the length of each of the pair of side frames **84** in the lateral direction **9**, i.e., the thickness of an edge portion **86** defining the fitting portion **71**.

As illustrated in the examples of FIGS. **4** and **5**, the bearing **70** is fitted into the fitting portion **71** of a corresponding one of the pair of side frames **84** from above with the third projecting portion **104** being oriented upward. More specifically, the edge portion **86** defining the fitting portion **71** is inserted into the groove **87** provided between the first projecting portion **102** and the second projecting portion **103**, whereby the bearing **70** is fitted in the fitting portion **71**. That is, the groove **87** is fitted onto the fitting portion **71**. In this manner, the bearings **70** are positioned on the pair of side frames **84** as illustrated in FIG. **5**. While FIG. **4** illustrates a state where the bearings **70** are yet to be fitted in the respective fitting portions **71**, FIG. **5** illustrates a state where the bearings **70** have been fitted in the respective fitting portions **71**.

The shaft **64** of the second roller **62** is inserted into the openings **106**. The second roller **62** that extends through the openings **106** is rotatable. Since the openings **106** extend in the vertical direction **7** as described above, the shaft **64** is movable in the vertical direction **7** along the openings **106**. FIGS. **5** and **8** illustrate a state where the shaft **64** is in contact with the upper ends of the openings **106**. FIG. **9** illustrates a state where the shaft **64** is in contact with the lower ends of the openings **106**. In the state illustrated in FIG. **9**, the bearings **70** support the shaft **64** of the second roller **62** while allowing the rotation of the shaft **64**.

As illustrated in FIGS. **7** to **9**, when the bearings **70** are in the respective fitting portions **71**, upper surfaces **79** (an exemplary contact portion according to the present invention) of the third projecting portions **104** are in contact with a lower surface **88** of the flat portion **51** of the guide rail **57** from below. The upper surfaces **79** are each longer in the anteroposterior direction **8** than in the lateral direction **9**. The pair of side frames **84** are each longer in the anteroposterior direction **8** than in the lateral direction **9**. That is, the upper surfaces **79** extend along the respective side frames **84**.

As illustrated in FIGS. **8** and **9**, positions **52** where the pair of side frames **84** support the guide rail **57** are on the front side with respect to the positions where the upper surfaces **79** of

the third projecting portions **104** are in contact with the flat portion **51** of the guide rail **57** from below. That is, the positions **52** do not coincide, in the transporting direction **15**, with the positions of contact between the guide rail **57** and the upper surfaces **79**.

When the bearings **70** are in the respective fitting portions **71** as illustrated in FIG. **5**, the third projecting portion **104** of one of the bearings **70** that is on the right side resides on the right side in the lateral direction **9** with respect to the positions **52** of the side frame **84** that is on the right side, while the third projecting portion **104** of the other bearing **70** that is on the left side resides on the left side in the lateral direction **9** with respect to the positions **52** of the side frame **84** that is on the left side. In other words, the upper surfaces **79** of the third projecting portions **104** reside on the outer side in the lateral direction **9** with respect to the positions **52** where the pair of side frames **84** support the flat portion **51** of the guide rail **57**.

[Lever Unit **90**]

As illustrated in FIGS. **4** and **5**, the printer section **11** includes the lever unit **90**. The lever unit **90** is supported by the upper surfaces **67** of the bent portions of the pair of side frames **84** in such a manner as to be movable in the anteroposterior direction **8**. The lever unit **90** is movable between the rear position illustrated in FIGS. **5** and **8** and a front position illustrated in FIG. **9** that is on the front side with respect to the rear position.

As illustrated in FIG. **6**, the lever unit **90** includes a handle **93** to be gripped by the user, a pair of connecting portions **94** extending rearward from the right and left ends, respectively, of the handle **93**, and a pair of guiding portions **95** extending rearward from the rear ends of the respective connecting portions **94**.

As illustrated in FIG. **1**, the handle **93** resides in the recessed portion **80** and near the opening **13**, more specifically, near the upper end of the opening **13**. As illustrated in FIG. **6**, the handle **93** extends in the lateral direction **9** and has an opening **96** in a central portion thereof in the lateral direction **9**. The user puts his or her fingers into the opening **96** and grips the handle **93**.

As illustrated in FIG. **6**, the pair of connecting portions **94** are each a long, flat-plate-like member whose long-side direction corresponds to the anteroposterior direction **8**. One of the pair of connecting portions **94** resides near the upper right corner of the recessed portion **80** and extends in the anteroposterior direction **8**. The other connecting portion **94** resides near the upper left corner of the recessed portion **80** and extends in the anteroposterior direction **8**. The housing **14** of the printer section **11** has grooves (not illustrated) provided in inner walls **81** (see FIG. **1**) thereof and extending in the anteroposterior direction **8**. The pair of connecting portions **94** have respective projections (not illustrated) projecting toward the grooves. The projections are fitted into the respective grooves. Hence, when the user grips and moves the handle **93**, the connecting portions **94** and the guiding portions **95** to be described separately below move in the anteroposterior direction **8**. The configuration of supporting the connecting portions **94** by using the housing **14** is not limited to the one described above.

As illustrated in FIGS. **4** and **5**, the guiding portions **95** extend in the anteroposterior direction **8** over a range from the second pair of rollers **44** to the rear side of the first pair of rollers **59**. The guiding portions **95** are provided in a pair, with one of them residing on the right side with respect to the right end of the transport path **65** and the other residing on the left side with respect to the left end of the transport path **65**. The guiding portions **95** are supported by the respective upper surfaces **67**.

The guiding portions **95** each have a guiding surface **91** and the guiding surface **89**. The guiding surface **91** includes a sloping surface **92** whose front end is at a higher position than the rear end thereof. The guiding surface **89** includes a sloping surface **98** whose front end is at a higher position than the rear end thereof, a horizontal surface **99** that is continuous with the front end of the sloping surface **98** and extends in the anteroposterior direction **8**, and a horizontal surface **100** that is continuous with the rear end of the sloping surface **98** and extends in the anteroposterior direction **8**.

[Movements of Second Roller **62** and Platen **42**]

A vertical movement of the second pair of rollers **44** that occurs along with the movement of the lever unit **90**, will now be described. When the lever unit **90** is at the rear position as illustrated in FIGS. **5** and **8**, the shaft **64** of the second roller **62** is supported by the supporting members **74**. Hence, the shaft **64** is urged upward by the coil springs **72**. Consequently, the shaft **64** is in contact with the upper ends of the openings **106** of the bearings **70** from below. Furthermore, the shaft **64** is in contact with the upper projections **76** of the platen **42** from below (see FIG. **3**A).

When the user grips the handle **93** and pulls the lever unit **90** frontward, the lever unit **90** moves frontward from the rear position. Hence, the supporting members **74** move frontward and away from the shaft **64**. Consequently, the shaft **64** that is under its own weight is supported by the sloping surfaces **92**. With the frontward movement of the lever unit **90**, the shaft **64** slides on the sloping surfaces **92**. Since the shaft **64** slides on the sloping surfaces **92**, the shaft **64** moves downward away from the upper ends of the openings **106** of the bearings **70**. The shaft **64** also moves away from the upper projections **76** of the platen **42**. Subsequently, when the lever unit **90** reaches the front position as illustrated in FIG. **9**, the shaft **64** is supported at the lower ends of the openings **106** of the bearings **70**.

A vertical movement of the platen **42** that occurs along with the movement of the lever unit **90** will now be described. As described above, when the lever unit **90** is at the rear position, the shaft **64** of the second roller **62** is in contact with the upper projections **76** of the platen **42** from below as illustrated in FIG. **3**A.

Furthermore, the supporting members **82** connected to the platen **42** via the respective coil springs **78** are supported by the respective horizontal surfaces **99** of the lever unit **90**. In this state, the platen **42** is urged upward by the coil springs **78**. Consequently, the upper surface of the platen **42** is in contact with the projecting portions **85** of the pair of side frames **84** from below.

When the lever unit **90** is moved frontward from the rear position, the shaft **64** moves downward as described above. Hence, the shaft **64** moves away from the upper projections **76** and presses the lower projections **77** from above. Consequently, the front side of the platen **42** moves downward.

Furthermore, when the lever unit **90** is moved frontward from the rear position, the supporting members **82** leave the respective horizontal surfaces **99** and come to be supported by the respective sloping surfaces **98**. When the lever unit **90** is further moved frontward, the supporting members **82** move downward by sliding on and moving relative to the respective sloping surfaces **98**. Thus, the coil springs **78** and the rear side of the platen **42** move downward, whereby the rear side of the platen **42** moves away from the projecting portions **85**. Ultimately, when the lever unit **90** reaches the front position, the supporting members **82** are supported by the respective horizontal surfaces **100** as illustrated in FIG. **3**B. In this manner, the platen **42** moves downward.

When the lever unit **90** is at the rear position, the second roller **62** and the spurs **63** are in contact with each other and are capable of transporting the recording sheet **12** while nipping the recording sheet **12** therebetween. When the lever unit **90** is at the front position, the second roller **62** and the spurs **63** are spaced apart from each other. When the lever unit **90** is at the rear position, the position of the platen **42** in the vertical direction **7** is determined such that the distance between the recording head **38** and the recording sheet **12** that is supported by the platen **42** is suitable for image recording.

When the lever unit **90** is moved from the front position to the rear position, the movement described above is realized in the reverse order. That is, the shaft **64** moves away from the sloping surfaces **92** and comes to be supported by the supporting members **74**, whereby the shaft **64** moves upward. Furthermore, the upper projections **76** are pushed upward by the shaft **64** that moves as described above, whereby the front side of the platen **42** moves upward. Furthermore, the supporting members **82** leave the respective horizontal surfaces **100**, move along the respective sloping surfaces **98**, and come to be supported by the respective horizontal surfaces **99**, whereby the rear side of the platen **42** moves upward.

[Effects Produced by Embodiment]

According to some example embodiments contemplated herein, the upper surfaces **79** of the bearings **70** are in contact with the guide rail **57** from below. Furthermore, the guide rail **57** supports the carriage **40** that carries the recording head **38**. Hence, the recording head **38** and the second roller **62** are positioned with reference to the guide rail **57**. Therefore, the accuracy in the relative positions of the recording head **38** and the second roller **62** is improved. Consequently, the accuracy in the relative positions of the carriage **40** carrying the recording head **38** and the second roller **62** supported by the bearings **70** is improved.

According to some example embodiments, the coil springs **72** urge the second roller **62** upward, whereby the accuracy in the position of the second roller **62** with respect to the recording head **38** is further improved.

According to some example embodiments, the openings **106** each extend obliquely with respect to the vertical direction **7** with the upper end thereof residing on the rear side with respect to the lower end thereof. Hence, the second roller **62** is movable in the vertical direction **7**. Even in such a case, the second roller **62** is positioned by the coil springs **72** and at ends of the respective openings **106** that are nearer to the guide rail **57**.

According to some example embodiments, the upper projections **76** of the platen **42** are in contact with the shaft **64** of the second roller **62** from above. Therefore, a portion of the platen **42** near the upper projections **76**, i.e., the front side of the platen **42**, is positioned with reference to the guide rail **57**. Hence, the accuracy in the relative positions of the platen **42**, the recording head **38**, and the second roller **62** is improved.

According to some example embodiments, the bearings **70** are each fitted into a corresponding one of the pair of side frames **84** from above with the groove **87** between the first projecting portion **102** and the second projecting portion **103** being fitted onto the fitting portion **71**. That is, there is no need to fit the bearings **70** into the respective side frames **84** in the lateral direction **9**. Therefore, the bearings **70** are attachable to the respective side frames **84** even if there are no spaces for moving the bearings **70** in the lateral direction **9**. Hence, the increase in the size of the multifunction machine **10** in the lateral direction **9** is suppressed.

According to some example embodiments, the spurs **63** are supported by the guide rail **57**. Therefore, as with the recording head **38** and the second roller **62**, the spurs **63** are positioned with reference to the guide rail **57**. Hence, the accuracy in the relative positions of the spurs **63**, the recording head **38**, and the second roller **62** is improved.

According to some example embodiments, the guide rail **57** is supported at two positions that are different in the anteroposterior direction **8**. Therefore, the position of the guide rail **57** is stabilized.

According to some example embodiments, since the flat portion **51** of the guide rail **57** extends in the lateral direction **9**, the carriage **40** is easily supported in such a manner as to be movable in the lateral direction **9**.

According to some example embodiments, since the upright portions **83** are provided, the rigidity of the guide rail **57** is increased. Hence, the guide rail **57** does not tend to bend easily. Consequently, the positional shift of the carriage **40**, which is supported by the guide rail **57**, due to the bending of the guide rail **57** is reduced.

[Modifications]

While the above embodiments describe examples where the respective openings **106** of the bearings **70** extend in the vertical direction **7**, the openings **106** may each have a circular shape instead of extending in the vertical direction **7**. In that case, the shaft **64** of the second roller **62** extending through the openings **106** is not vertically movable, unlike the case according to the above embodiment.

If the second roller **62** is not vertically movable as described above, the coil springs **72** may urge the respective bearings **70** instead of the second roller **62**. In that case, the coil springs **72** urge the second roller **62** via the respective bearings **70**.

While the above embodiments concern instances where the second roller **62** corresponds to the transporting roller according to the present invention, the first roller **60** may correspond to the transporting roller according to the present invention and may be supported by bearings each having the same shape as the bearing **70**. Moreover, if any other roller is provided in the multifunction machine **10**, that roller may correspond to the transporting roller according to the present invention and may be supported by bearings each having the same shape as the bearing **70**.

While the above embodiments concern instances where the guide rail **57** corresponds to the first support member according to the present invention, the guide rail **56** may correspond to an exemplary first support member according to the present disclosure. In that case, the first roller **60** provided below the guide rail **56** corresponds to the transporting roller according to the present invention, and the first roller **60** is supported by bearings each having the same shape as the bearing **70** such that the upper surfaces of the bearings are in contact with the guide rail **56** from below.

While the above embodiments concern instances where the upper surface of the platen **42** that is urged upward by the coil springs **78** comes into contact with the projecting portions **85** of the pair of side frames **84** from below, the upper surface may come into contact with either of the guide rails **56** and **57** from below. In that case, portions of the guide rail **56** or **57** to which the upper surface comes into contact correspond to exemplary platen contact portion according to the present invention.

If, in some embodiments, the upper surface of the platen **42** comes into contact with either of the guide rails **56** and **57** from below as described above, the rear side of the platen **42** is positioned with reference to the guide rail **56** or **57**. In this case, the front side of the platen **42** is also positioned with reference to the guide rail **56** or **57** as described in the above embodiment. That is, the entirety of the platen **42** is positioned with reference to the guide rail **56** or **57**. Consequently,

the accuracy in the relative positions of the platen **42**, the recording head **38**, and the second roller **62** is improved.

While the above embodiments concern instances where the second roller **62** is vertically movable, the first roller **60** may also be vertically movable. In that case, the first roller **60** may be vertically moved by a known mechanism or by a mechanism that is the same as the mechanism that vertically moves the second roller **62**.

If, in such embodiments, the first roller **60**, the second roller **62**, and the platen **42** are vertically movable, the multifunction machine **10** is capable of transporting, along the linear portion **34**, not only the recording sheet **12** but also a recording medium that is thicker than the recording sheet **12**, such as a compact-disc read-only memory (CD-ROM) or a digital-versatile-disc read-only memory (DVD-ROM), or a medium tray supporting such a recording medium. Furthermore, if the first roller **60**, the second roller **62**, and the platen **42** are vertically movable, any recording sheet **12** that may be stuck in the linear portion **34** is easily removable.

Although in the example embodiments discussed herein, various relative directions are disclosed, including but not limited to up, down, left, right, rear, front, and vertical or horizontal directions, it is noted that these terms are intended to represent relative positions of elements of the embodiments described herein, and not intended to describe absolute relative positions of the components, members, or machine disclosed. Rather, other orientations of the various components discussed herein are contemplated, and as such the present disclosure is not limited to the directional arrangement described above in connection with some embodiments.

The description and illustration of one or more embodiments provided in this application are not intended to limit or restrict the scope of the invention as claimed in any way. The embodiments, examples, and details provided in this application are considered sufficient to convey possession and enable others to make and use the best mode of claimed invention. The claimed invention should not be construed as being limited to any embodiment, example, or detail provided in this application. Regardless of whether shown and described in combination or separately, the various features (both structural and methodological) are intended to be selectively included or omitted to produce an embodiment with a particular set of features. Having been provided with the description and illustration of the present application, one skilled in the art may envision variations, modifications, and alternate embodiments falling within the spirit of the broader aspects of the general inventive concept embodied in this application that do not depart from the broader scope of the claimed invention.

What is claimed is:

1. An inkjet recording apparatus comprising:

a carriage configured to support a recording head that is configured to eject ink from nozzles onto a recording medium to be conveyed;

a first support member supporting the carriage, the carriage being movable in a scanning direction orthogonal to a transporting direction of the recording medium;

a second support member separate from and configured to support the first support member;

a transporting roller extending in the scanning direction and rotatable to transport the recording medium in the transporting direction; and

a bearing disposed at the second support member and supporting the transporting roller rotatably, the bearing comprising a flat upper surface that contacts the first support member and a contact member comprising a first projecting portion and a second projecting portion,

wherein the second support member is secured between the first and second projecting portions and wherein the first projecting portion and the second projecting portion are positioned along a line parallel with an axis of the transport roller in the scanning direction.

2. The inkjet recording apparatus of claim **1**, whereby relative positions of the carriage and transporting roller in a direction orthogonal to both the scanning direction and the transporting direction are maintained.

3. The inkjet recording apparatus of claim **1**, wherein the bearing is attached to the second support member.

4. The inkjet recording apparatus of claim **1**, wherein the flat upper surface is offset in a scanning direction from the second support member.

5. The inkjet recording apparatus according to claim **1**, further comprising:

a pair of second support members configured to support the first support member, the second support members spaced apart from each other in the scanning direction; and

a pair of bearings, the bearings disposed at the second support members, respectively; and

wherein the each of the pair of bearings comprising the contact member.

6. The inkjet recording apparatus according to claim **1**, further comprising a first urging member configured to urge one of the bearing and the transporting roller toward the first support member.

7. The inkjet recording apparatus according to claim **6**, wherein the bearing has an opening through which the transporting roller passes,

wherein the opening extends in a direction orthogonal to both the transporting direction and the scanning direction, and

wherein the first urging member is configured to urge the transporting roller toward the first support member.

8. The inkjet recording apparatus according to claim **1**, further comprising:

a platen facing the recording head and configured to support the recording medium conveyed by the transporting roller, the platen comprising a roller contact portion configured to contact the transporting roller,

a platen contact portion disposed at one of the first support member and the second support member and configured to contact the platen, and

a second urging member configured to urge the platen toward the platen contact portion.

9. The inkjet recording apparatus according to claim **8**, further comprising a first urging member configured to urge the transporting roller toward the first support member,

wherein the roller contact portion is located between the first support member and the transporting roller in a direction orthogonal to both the transporting direction and the scanning direction,

wherein the platen portion is located at a position different from the roller contact portion in the transporting direction, and

wherein the second urging member is located at a position different from the first urging member in the transporting direction.

10. The inkjet recording apparatus according to claim **1**, wherein the second support member comprises a fitting portion that has an opening extending from an upper end of the second support member,

wherein the bearing comprises a first projecting portion projecting from a circumferential surface of the bearing and a second projecting portion projecting from the cir-

cumferential surface of the bearing and spaced apart from the first projecting portion in the scanning direction, and

wherein the bearing is configured to engage with the fitting portion such that the fitting portion is located between the first projecting portion and the second projecting portion.

11. The inkjet recording apparatus according to claim **1**, further comprising a follower roller disposed facing the transporting roller,

wherein the transporting roller and the follower roller are configured to nip the recording medium there between and transport the recording medium, and

wherein the follower roller is disposed at the first support member.

12. The inkjet recording apparatus according to claim **1**, wherein a position where the second support member supports the first support member is different from a position where the contact portion is in contact with the first support member with respect to the transporting direction.

13. The inkjet recording apparatus according to claim **1**, wherein the first support member comprises a flat portion extending in the scanning direction, and

wherein the contact portion is configured to contact the flat portion.

14. The inkjet recording apparatus according to claim **13**, wherein the flat portion comprises an upright portion that extends from an end portion of flat portion in the transporting direction.

15. The inkjet recording apparatus according to claim **1**, wherein the support member including a first surface and a second surface, the first surface being opposite to the second surface in a direction perpendicular to both the transporting direction and the scanning direction,

wherein the carriage contacts the first surface of the first support member, and

wherein the contact portion contacts the second surface of the first support member.

16. A method of operation of an inkjet recording apparatus, the method comprising:

movably mounting a carriage to a first support member, the carriage configured to support a recording head that is configured to eject ink from nozzles onto a recording medium to be conveyed;

positioning a bearing at a second support member separate from the first support member and at a contact member comprising a first projecting portion and a second projecting portion, wherein the second support member is secured between the first and second projecting portions, the bearing rotatably supporting a transporting roller that extends in a scanning direction and wherein the first projecting portion and the second projecting portion are positioned along a line parallel with an axis of the transport roller in the scanning direction; and

maintaining contact between a flat upper surface of the bearing and the first support member.

17. The method of claim **16**, further comprising maintaining relative positions of the carriage and transporting roller in a direction orthogonal to both the scanning direction and the transporting direction.

18. An inkjet recording apparatus comprising:

a carriage configured to support a recording head that is configured to eject ink from nozzles onto a recording medium to be conveyed;

a guide rail supporting the carriage, the carriage being movable in a scanning direction orthogonal to a transporting direction of the recording medium;

at least one side frame supporting the guide rail;

a transporting roller extending in the scanning direction and rotatable to transport the recording medium in the transporting direction; and

a bearing attached to the at least one side frame and supporting the transporting roller rotatably, the bearing comprising a contact portion comprising a first projecting portion and a second projecting portion, wherein the at least one side frame is secured between the first and second projecting portions at an opening of the at least one side frame, and wherein the first projecting portion and the second projecting portion are positioned along a line parallel with an axis of the transport roller in the scanning direction.

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